Green Chemistry Work Group Recommendations coordinated by Brian Dancause

Convene a green chemistry summit, bringing together academia, industry and policymakers. The summit will highlight the following green chemistry research and development opportunities for Maine:

-- potato-based polylactic acid (PLA)
-- nanotechnology (see additional background and recommendation info on nanotechnology below from John Wise)

John Wise Nanotechnology Background and recommendations

Nanotechnology is considered to be the next industrial revolution and to become a 1 trillion dollar industry within the next 10 years. The federal government is already investing $1 billion in nanotechnology development. Nanoparticles are currently in over 300 commercial products including sunscreen, stain-resistant clothing, tires, refrigerators, washing machines and sports equipment. They are in clinical trials for drug delivery in diseases such as pancreatic cancer, and the National Institutes of Health (NIH) has announced 4 new nanomedicine centers. The military is using nanomaterials to develop advances in electronics, munitions, propellants, fuels, nanocomposites, nano-controlled dielectrics and nanoscale photonics. We are at the beginning of the nanotechnology era.

Nanoparticles are defined as having at least one dimension less than 100 nm. They exist in the quantum scale, which means that they don't follow the laws of solids, liquids or gases. Instead, they follow the laws of quantum mechanics, which gives them their value. They exhibit mechanical, magnetic, electronic and color properties unachievable by these chemicals at larger sizes. However, the same properties that make these particles an exciting technology also make them daunting environmental health concerns. Simply put, it is unknown how these new properties will enhance, diminish or otherwise alter the toxicity of the compounds that they are made from because the toxicity of nanoparticles is uncertain and relatively unexplored.

Engineered nanoparticles clearly exhibit toxic effects as rodent studies have shown that inhaled nanoparticles accumulate in the nasal passage, lung and brain where they can cause lesions that interfere with oxygen absorption and cause suffocation due to immune system cells clumping around the nanotubes and blocking bronchial passages. Recently, it has been shown that lower doses also cause respiratory toxicity including proinflammatory and fibrotic responses. Cell culture studies confirm the toxicity of engineered nanoparticles reporting cytotoxicity, decreased cell viability and the production of proinflammatory agents. These cell culture studies indicate that size and particle composition can dramatically modify toxicity, with some sizes and forms being highly toxic and others nontoxic.

The actual dose range of nanomaterials to which the environment is likely to be exposed is currently uncertain as the technology is still very new. However, given the broad spectrum of applications and widespread use, exposure is expected to become common and frequent. For example, considering silver nanoparticles, exposure scenarios are numerous. One population that will certainly be exposed is workers who manufacture silver nanomaterials and who assemble these materials into products. These exposures are expected to be high, though mitigated by personal protective equipment and engineering controls. The nanomaterials are expected to be both agglomerated and monodispersed as the products are made, with the

primary exposure route likely to be through inhalation, followed by dermal exposure, with oral ingestion being infrequent.

Another large population to be exposed will be the consumers and users of those products. Silver nanoparticles have a broad spectrum of commercial uses including toothpaste, clothing, washing machines, refrigerators and paints. Thus, consumers will be exposed orally through their direct use in toothpaste, dermally through their direct use in clothing and washing machines and by inhalation through exposure to paint and nanodusts. Given the history of lead in paint, oral exposure in very young children is likely as well.

A third exposure scenario is through an environmental route and will affect the public in general, whether or not they choose to use nanomaterials. Ultimately, these materials will enter the environment though air and water releases such as catalytic converter exhaust and paint chips released from vehicles, and water released from washing machines, among others. These air and water cycles will carry nanomaterials across the globe, in a manner such as that already documented for numerous other chemicals such as mercury. For silver nanoparticles, release into the general environment is direct and virtually assured.

For example, consider just one commercial product with silver or gold nanomaterials. Silver nanoparticles are currently in use in the 'WF300' series of washing machines made by Samsung. This series consists of 6 models each featuring "Silver Care" and currently on sale at your local Best Buy and Lowe's store. "Silver Care" is provided by two plates consisting of 99.9% pure silver nanoparticles and the interior is coated with silver nanoparticles. Samsung reports that in addition to silver ions, each load releases 4 million nanoparticles into the water that penetrate into the laundry. In cold water, the silver nanoparticles can sanitize and kill odor-causing bacteria and continue "shielding them out" by remaining in clothes "for about a month". Thus, the laundry can be cleaned in cold water instead of hot making the machine more energy efficient and since it is competitively priced (currently on sale for $899), it is likely to become a popular machine and to be imitated by other manufacturers.

There are approximately 85 million households with washing machines in the U.S. On average, these households wash 1.07 loads of laundry each day. Given Samsung's statement that each laundry load delivers 4 million nanoparticles, if their new exciting machine captures just 10% of the U.S. market (currently its global market share is 11%, but in the US it is about 4%), that would be 8.5 million households each doing 1.07 loads of laundry per day, each load delivering 4 million silver nanoparticles resulting in the release of about 36 trillion nanoparticles into the waste stream EACH DAY (or about 13 quadrillion per year) from just this one source. Of course this number only considers the potential U.S. market, and thus, the daily release of silver nanoparticles can be expected to be much higher when worldwide markets are considered since Samsung already has 15% of the Indian washing machine market and 47% of the Korean market (19-20). Moreover, these releases will rise dramatically if other manufacturers mimic this technology. The full exposure potential to silver nanoparticles will of course be still higher as this calculation only considers washing machines and excludes the numerous other consumer products containing silver nanoparticles, which will ultimately significantly contribute to any exposure scenario.

There are of course numerous types of nanomaterials. As we push forward, Maine should assume a leadership position and manage the safety of this novel new class of compounds and encourage and stimulate more measures and research to maximize their benefits and minimize their risk. In particular, we should build expertise in the design of more environmentally and

health friendly nanomaterials or "green-nano" and in the evaluation of its toxic potential.

Information/Chemicals Policy Work Group Recommendation including feedback from the IPM Council coordinated by Kathy Murray

New Recommendations from Info/Policy Work Groups

1. Support the establishment of a chemical information clearing house within NEWMOA, possibly through the expansion of iMERC (mercury information and use database) to include information on priority (PBTs, carcinogens/mutagens/teratogens, endocrine disruptors, high production and use chemicals, and acute toxins?) chemicals.
2. Support mandatory reporting and enforcement of chemical use by manufacturers and distributors.
3. Require full disclosure of all hazardous chemicals on MSDS for products used in the public sector.
4. Support development of a chemical risk analysis process such as that being implemented in Canada.
5. Implement state policies for chemical hazard communication in harmony with international requirements (Global Harmonization System).
6. The State should provide adequate support to the Maine Board of Pesticides Control to enforce regulations governing pesticide use on school properties and in other public buildings through regular and thorough on-site inspections.
7. The State should provide support for university research faculty in ecology and engineering programs to support development of least-toxic and/or non-chemical alternatives to pesticides and other toxic chemicals used in Maine.

Recommendations from the Interim Report on expanded consumer and retailer education to promote markets for safer alternatives

8. Provide general education through a website and educational materials that provide some guidance and education on non chemical solutions to problems and safer chemicals when they are necessary, safer chemicals, and include an outreach campaign to guide the public seeking such information to such materials.
9. Educational resources developed for the Maine School IPM Program and the State's BGS IPM Policy should be promoted as adaptable models for implementation of IPM on other public and private properties including hospitals, colleges, multiple family residences, and commercial properties.
10. Increase support for public and retailer pest management and pesticide education.
11. Increase graduate level education in toxicology and environmental health by dedicating 1-2 fellowships in the Graduate School of Biomedical Sciences to the newly formed Toxicology and Environmental Health track in that program.
12. Increase undergraduate level education in toxicology and environmental health by providing funding for faculty hires to expand the "Toxicology and Environmental Health" minor at USM to an undergraduate major that students can specialize in. University programs should also
13. Investigate appropriateness of access to K-12 curriculums in alignment with the Maine Learning results focused on:
    A. Toxicology and environmental health and
    B. Integrated Pest Management.

Recommendations from Interim Report to support efforts to enhance current state initiatives

14. Accept the offer of the SEIU Hazard Materials Awareness Training Program to conduct Hazard Materials Awareness training on janitorial products. The program would train Bureau of General Services staff on new janitorial supplies that will be purchased through the evolving Environmentally Preferable Procurement contract for Janitorial Supplies. This would enhance efforts of BGS janitorial staff to safely use the new janitorial products being introduced through Environmentally Preferable Procurement.

14. Provide BGS with the authority and resources needed to fully implement the State of Maine IPM Policy.

15. Make the necessary support and resources available to implement an effective record-keeping system to track pesticide use, pest monitoring records, IPM actions, and pest and pesticide-related complaints in state facilities.

Sharon Tisher Recommendations

State policy should enhance efforts and opportunities, on both state and national levels, to:

Close the Data Gap: Ensure that chemical producers generate, distribute, and communicate information on chemical toxicity, ecotoxicity, uses, and other key data.

Close the Safety Gap: Strengthen government tools for identifying, prioritizing, and mitigating chemical hazards.

Close the Technology Gap: Support research, development, technical assistance, entrepreneurial activity, education in green chemistry science and technology.

Where possible, these efforts should be in conjunction and in collaboration with other states pursuing the same goals.

A. Closing the Data Gap

MSDS reform

Material Safety Data Sheets (MSDS's) are regulated by the U.S. Occupational Health and Safety Administration, as well as some other federal and state agencies, for the purpose of communicating hazards to which workers may be exposed. In the absence of alternative resources, however, they have become the major source of information about chemical hazards, not only for workers and labor organizations, but also for manufacturers seeking to investigate and select chemical components of their products, and for consumers concerned about health effects of their retail purchases. The National Library of Medicine's Household Products Database, one of the few sources of public information about ingredients in household products, relies primarily on MSDS's to develop their information about the ingredients and potential health effects of those products.

MSDS's , however, are far from adequate. Mark Catlin, Industrial Hygienist and Haz Mat Project coordinator for the Service Employees International Union (SEIU) advised us that they fail to reflect significant reports of adverse reactions and up to date research. Manufacturers represented on the Task Force have observed that some MSDS's meeting State of Pennsylvania MSDS requirements are more informative than federal MSDS's.

If a toxic chemical comprises less than 1% of a compound, it is not required to be listed on the compound's federal MSDS, unless the chemical is a carcinogen. Pennsylvania requires the listing of "every chemical contained in the substance which comprises 3.0% or more of the substance, except that hazardous substances shall be listed if they comprise 1.0% or more of the substance, and special hazardous substances which comprise 0.01% of more of the substance shall be listed." (Penn Code, Ch. 307, sec. 307.2 (2)) A "special hazardous substance" is defined as "A hazardous substance so designated by the department because of its particular toxicity, tumorigenicity, mutagenicity, reproductive toxicity, flammability, explosiveness, corrosivity or reactivity poses a special hazard to health and safety."

OSHA has no requirement that the persistence or bioaccumulative qualities of a chemical be reported on MSDS's, as the agency regards those as issues of "environmental fate" unrelated to worker safety. Nor does it require disclosure of whether a chemical is an endocrine disrupting chemical.

The OSHA Hazard Communication Standard, 29 CFR 1910.1200, moreover, exempts manufactured items ("articles") "which do[es] not release, or otherwise result in exposure to, a hazardous chemical under normal conditions of use," as well as consumer products, when the use results in a duration and frequency of exposure in the workplace which is not greater than the range of exposures normally experienced by consumers. Despite these limitations, the scope of disclosure in OSHA MSDS's could and should be broadened, both nationally and in this state, in order to provide
workers, consumers, and manufacturers with better information regarding the safety chemical products.

Revision of OSHA standards
We recommend that, in conjunction with the reexamination of the OSHA Hazard Communication Standard (HCS) in light of the Global Harmonization System (GHS), OSHA incorporate in the HCS the GHS disclosure recommendations for persistence and bioaccumulation of a chemical. A letter from the Commissioner of Environmental Protection and the Commissioner of Labor making this recommendation is appended as ____.

New Maine public employee only occupational safety and health HCS standard.

Maine statutes empower the Occupational Safety Rules and Regulations Board to make rules for safe and healthful working conditions for public employees, which "shall at a minimum conform to federal standards of occupational safety and health." (26
M.R.S.A. sec. 565). The Board has currently incorporated by reference all OSHA regulations, including the HCS/ MSDS requirements. We recommend that the OSRRB promulgate a new MSDS requirements which adopts the Pennsylvania standard listed above,
with the addition under the category of "special hazardous substance" of the categories of endocrine disruption, persistence, and bioaccumulation. We also recommend that the Board include provisions for filing MSDS's with the DEP, and for public access to the MSDS's on file with the DEP, comparable to Penn statutory provisions sec.s 307.10 and 307.15.

[We need to determine whether we want to simply expressly piggyback on the Pennsylvania list for determining special hazardous substances, or reference other lists. Clearly we need to reference other lists for endocrine disruption, persistence, and
bioaccumulation.
The Pennsylvania list is at: http://www.dli.state.pa.us/landi/CWP/view.asp?a=185&Q=167828

If you have any trouble negotiating their website, the operator at 717 783 2071 is very helpful. This is the complete haz substances list;
special hazardous substances are marked with an "s". The hazardous substances list under the New Jersey Right to Know Act may be an alternative reference point.]

Use notification for priority chemicals.

Maine statutes, 38 M.R.S.A. sec. 1661-A,
http://janus.state.me.us/legis/statutes/38/title38sec1661-a.html
requires that manufacturers of products "to which mercury is intentionally added"
must provide notification to the DEP describing the product, its purpose, the amount of mercury in each product, and the total amount in all products sold in the US. Five other states have enacted similar legislation, and cooperate in pooling information garnered through this notification to develop the NEWMOA Mercury in Products Database. Searchable on line, this database has been invaluable in identifying major sources of exposure to mercury, and prioritizing regulatory responses to reducing that exposure.

By contrast, we were advised by John James, DEP Bureau of Remediation and Waste Policy Director and co-author of the 2007 report to the legislature on Brominated Flame Retardants, that it was extremely difficult to identify major (and minor) uses
of BFRs. There is no federal requirement of use disclosure. Manufacturers are under no legal obligation to supply such information if requested by state authorities. Without such an obligation, manufacturers may not trouble themselves to query
distributors regarding ultimate uses of their chemicals.

Use information regarding highly toxic chemicals is a key predicate to effective regulation, and public right to know. It enables identification of major sources of human exposure, and of exposure to the most vulnerable populations, such as children and infants, pregnant women, and the elderly. 38 M.R.S.A. sec. 1661-A provides proven and effective precedent for extension of protections to Maine citizens from toxic exposures through better information. We recommend that sec. 1661-A be amended to include the following priority chemicals, plus any additional chemicals identified for prohibition or virtual elimination under Canada's Chemicals Management Plan pursuant to the Canadian Environmental Protection Act 1999.

Priority chemicals: lead, formaldehyde, phthalates, bisphenol A, BFRs, etc....???..

[Note that Mike Wilson advised that a bill currently in the Cal. legislature, SB 578, would require such use information for all HPV chemicals sold in California. S.B. 973 would require manufacturers to report to the state when any of their products contain chemicals targeted for virtual elimination by Canada]

DEP web page [Note from Ginger. DEP has had the following website placeholder Safer Chemicals website up since July of 2005 that is accessed through the DEP website http://www.maine.gov/dep/oc/saferchemicals.htm .]

We should proceed to complete implementation of the directive contained in the Executive Order to establish a DEP "Safer Chemicals" web page that has links to the EO, the Task Force Reports, and other helpful resources we have identified along the way...the National Library of Medicine Household Products Database,
the Consumers Union evaluation of eco labels (www.eco-labels.org),

the Green Seal website.

B. Closing the Technology Gap

Green Chemistry Program for Sustainable Production (GCPSP)

The Green Chemistry Program for Sustainable Production (GCPSP) which was outlined in the Interim Report should be viewed as the key infrastructure component to the development, advancement and implementation of the Chemicals Policy which is being developed by the Task Force and recommended to the Governor.

The GCPSP, which will be an integrated program between the University of Maine and the University of Southern Maine, builds on the early effort of the Green Chemistry initiative at the University of Maine through its participation in the New England Green Chemistry Consortium and builds on the existing strengths of the Chemical Engineering Department at the University of Maine and Center for Environmental Toxicology at the University of Southern Maine. The vision for the GCPSP includes close collaboration with other New England institutions of higher learning, non-profit organizations which are playing a key role in the development of sustainability guidelines, and industry leaders in the sustainable bio-based products industry.

The framework for this model should incorporate the key elements of California's efforts in this area which were outlined to the Task Force in a presentation by Michael Wilson from the University of Calif. It should also include the expanded product information on the toxicity of products which were addressed in the Taskforce letter to OSHA.

Support for Maine's Emerging Bio-based Plastics Industry

Interface Fabric was awarded a Seed Grant from the Maine Technology Institute in November 2007 to research whether there is a sufficient source of starch from Maine potatoes to support the production requirements for a PLA facility in Maine. These results were presented to the Green Chemistry Subcommittee and form the basis for recommending that the State of Maine be proactive in support of the research and economic development needs of this sector. Support for this approach was included in the Research and Development Bond Bill which was passed by the Legislature and signed by the Governor in April 2007 and will be submitted to the voters in November 2007. There was strong support for this initiative from industry, Maine's economic development agencies and also from Maine's university researchers.

The research conducted by the Margaret Chase Smith Policy Center at the University of Maine and presented in the "Potatoes to Plastics" report, concluded that:

ÿ There is a sufficient supply of starch for Maine's agricultural sector to move forward in pursuit of developing this new opportunity for Maine's potato growers, and;
ÿ There is sufficient supply for Maine's emerging bio-plastics industry to attract venture capital to build a facility to supply Maine's industry needs with a bio-based plastic feedstock from potatoes for their products.

This builds on a growing trend within this advanced manufacturing sector to use bio-based plastics to replace existing petroleum derived products. This demand is currently being met with corn derived plastic feed stocks from the Midwest.

Preferential Purchase of Sustainably Manufactured Bio-based Products by State government, the University and other public institutions.

The number of bio-based products which are available is constantly growing. These products are less toxic than other products and therefore present an opportunity for public funds to protect the environment, reduce toxic exposures and support Maine's emerging bio-based products industry. The sustainability guidelines for bio-products purchasing are being developed by such organizations as: The Healthy Building Network, the Institute for Agriculture and Trade Policy, Clean Production Action and the Institute for Local Self Reliance. The state, its agencies, and public institutions such as schools, hospitals and the university should adopt preferential purchasing requirements for sustainably manufactured bio-based products with an additional preference for bio-products made in Maine.

Green Chemistry Summit (
To promote the understanding of the Task Force's Recommendations, a Green Chemistry Summit or Blaine House Conference should be organized to review the Taskforce's Report and also to promote the recommendations it contains. This would be an excellent forum to introduce the emerging bio-based plastics industry and the non-toxic products it offers to consumers, as well as the opportunity to discuss the Green Chemistry Program for Sustainable Production and the need to support R &D funding for this important economic initiative.

C. Closing the Safety Gap

Require Green cleaning and disinfecting products in Maine schools.

Children are among the most vulnerable populations at risk from exposure to toxic chemicals, and children spend many hours a week in Maine schools. Maine has one of the highest rates of child and adult asthma in the nation. Research suggests that reduction in the toxicity of chemicals used in schools may reduce student and staff illness, absenteeism, and health effects including asthma episodes. In recognition of the importance of shifting to safer janitorial products in Maine schools, on May 18, 2007 the Governor approved a legislative Resolve, S.P. 32-L.D. 88, Resolve, To Encourage the Use of Safe Chemicals in Public Schools.
http://janus.state.me.us/legis/LawMakerWeb/externalsiteframe.asp?ID=280022389&LD=88&Type=1&SessionID=7 The Resolves outlines voluntary efforts to identify safer cleaning and disinfecting products, and to encourage schools to commit to implementing a green cleaning program. We recommend that legislation proceed further to mandate use of safer cleaning and disinfecting products in Maine schools.

Survey/compliance investigation on IPM in Schools Regulation

In 2002, the Maine Board of Pesticides Control adopted comprehensive regulations requiring use of Integrated Pest Management in Maine schools, and parental and staff notification of pesticide use. The regulations were adopted in part as a result of a survey showing widespread illegal use of pesticides in Maine schools by custodial staff unlicensed to apply pesticides, and after review of substantial scientific evidence that children are particularly vulnerable to risks from pesticide exposure. The BPC lacks funds to adequately monitor compliance with these regulations. We recommend an effort to identify federal or foundation funding to survey and/or otherwise ascertain and encourage compliance with these mandates in Maine schools.

Funding for pesticides education

Homeowner use of pesticides, particularly mixed fertilizer/pesticide preparations for lawn care, either directly or through lawn care services, is dramatically on the rise in Maine.
Jim Dill has submitted legislation, L.D. 1798,
http://www.mainelegislature.org/legis/bills/billtexts/ld179801.asp
to place a $.15 per container fee on retail non-agricultural pesticide products to fund efforts by the BPC and the Cooperative Extension to educate consumers about safe pesticide use, and safer non chemical alternative means of pest control.
Depending on the outcome of current negotiations on this bill, we should state a position in favor of this concept, or alternatively of funding this education through an increase in the pesticide registration fee paid by distributors (thus eliminating the burden of collection of the fee on retailers).

Mike Belliveau Recommendations

As detailed in the Task Force's interim report, our safety system for industrial chemicals is broken and needs to be fixed. Chemical policy reform must serve to close the safety gap, close the data gap and close the technology gap, as described in the green chemistry report prepared by the University of California at Berkeley.

The following policy elements should be advanced in legislative reform at the state and/or federal level to ensure a more comprehensive safer chemical policy.

1) Focus on industrial chemicals that may escape from consumer products and everyday materials, rather than chemical emissions from industrial facilities

Intent: *Chemical releases to air and water are already regulated; Products add toxicity to the waste stream at the end of life and are responsible for considerable human exposure, yet remain largely unregulated as sources of chemical releases.*

2) Emphasize chemical uses that pose a threat to children's health, including the potential for chemicals in products to expose fetuses, infants and toddlers

Intent: *Evidence mounts about the extra susceptibility of the developing fetus and child to the effects of toxic chemicals, and the importance of the early life environment to chronic diseases in adults.*

3) Require timely submission and regular updating of a minimum data set on health and safety hazards and environmental fate from chemical manufacturers

Intent: *We need to close the data gap on chemical hazards to enable intelligent choices.*

4) Also, require timely submission of data on chemical uses, especially in products, from chemical manufacturers and from product manufacturers

Intent: *Consumers, businesses and policy makers need to know which products and materials contain which chemicals in order to take protective actions.*

5) Review all chemicals in commerce and sort them based on available hazard data: Tier I – Chemicals of High Concern, Tier II – Chemicals of Concern, Tier III – Chemicals of Unknown Concern, and Tier IV – Chemicals of Low Concern

Intent: *Similar to what Canada has accomplished, we need to review and categorize all chemicals so that resources can be focused according to the degree of hazard posed.*

6) Tier I – Chemicals of High Concern should include persistent bioaccumulative toxic chemicals (PBTs), very persistent very bioaccumulative chemicals (vPvB), and chemicals that are known to cause or probably cause toxic effects in humans, including cancer, genetic mutations, birth defects, developmental or reproductive harm, damage to the nervous system or immune system, endocrine disruption or other chronic toxicity

Intent: *These are the worst-in-class chemicals. Everyone needs to know what these are so that voluntary and mandatory actions can be taken to avoid the worst chemicals.*

7) A process should be established to systematically phase-out priority uses of Tier I chemicals in favor of safer alternatives, for example through chemical action plans (like in Washington state) or Maine's actions on mercury and BFRs

Intent: *There should be a presumptive ban on worst-of-worst chemicals providing that safer alternatives are available, within available resources for implementation*

8) Tier II - Chemicals of Concern should include other hazardous chemicals, including those for which hazard data are more limited than for Tier I

9) Government authority should be created to require safer alternatives to Tier I or Tier II chemicals

10) Product manufacturers should be required to conduct alternatives assessments and prepare substitution plans for Tier I and II chemicals

11) Manufacturers should be required to demonstrate that their chemical use is safe, especially for children, and to reduce uses below a protective safety standard taking into account cumulative exposures to the most sensitive population

12) Chemical manufacturers and downstream users should be required to close the data gaps on Tier III - Chemicals of Unknown Concern

13) Incentives, financial assistance and R&D funding should be applied to identify, develop and promote the use of Tier IV – Chemicals of Low Concern

14) Establish an Interstate Clearinghouse for Safer Chemicals to formalize cooperation between the states in managing and implementing safer chemical policies

15) Funding necessary to implement a new chemicals policy should be based on the "polluter pays principle," such that fees on the worst chemicals and user fees for data submissions should pay the full costs to government to administer the program.